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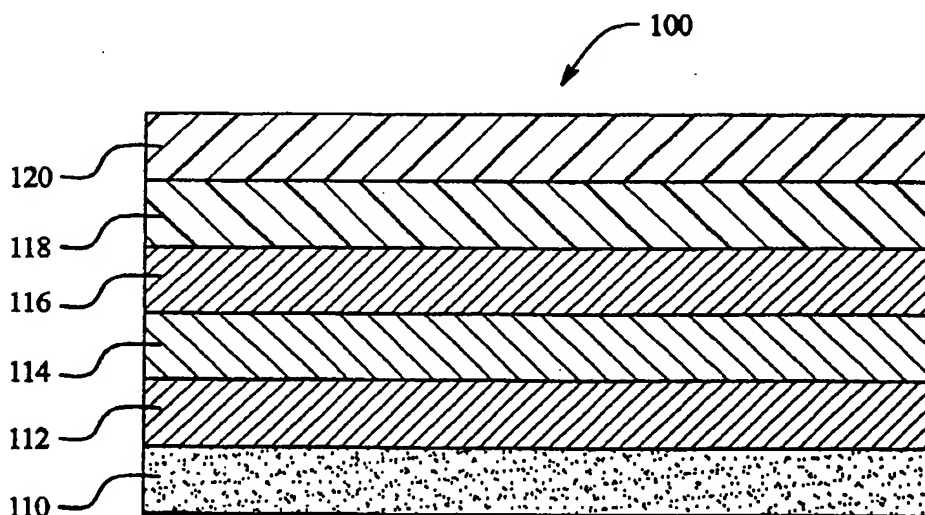
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(54) Title: FILMS HAVING A DESICCANT MATERIAL INCORPORATED THEREIN AND METHODS OF USE AND MANUFACTURE



(57) Abstract: Film structures (100), packages and methods of making the same are provided wherein the film structures (100) have a desiccant material incorporated into a sealant layer (110) of the films structures (100). More specifically, the film structure (100) further includes a barrier material (114) incorporated as an internal film layer within the film structure. The film structure (100) may also include a first tie layer (112) between the sealant layer (110) and the barrier layer (114), and a second tie layer (116) and primer or printed layer (118) between the barrier layer (114) and an outer layer (120). The film structure is utilized for a package to hold a product that may be sensitive to the presence of moisture. The product may preferably be diagnostic test strips useful in the medical or pharmaceutical field.



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**FILMS HAVING A DESICCANT MATERIAL INCORPORATED
THEREIN AND METHODS OF USE AND MANUFACTURE**

5 Field of the Invention

 The present invention relates to a film having a desiccant material incorporated therein. More specifically, the present invention relates to a film structure having a desiccant material within a sealant layer of the film structure wherein said film structure is utilized as a package for a product that may be sensitive
10 to the presence of moisture. In addition, the present invention relates to methods of manufacturing and methods of using the film having a desiccant material incorporated therein.

Background of the Invention

 It is generally known to utilize plastic packaging to reduce exposure of
15 products to atmospheric conditions, such as to moisture or oxygen, which may damage the products. For example, packaging for foodstuffs is well known, in that moisture and oxygen may cause the foodstuffs to become spoiled and inedible or otherwise undesirable. In addition, many products in the medical field may also be very sensitive to atmospheric moisture.

20 Typically, moisture-sensitive products may be encased in thermoplastic material that is relatively impermeable to water molecules. Specifically, many polymeric materials are utilized as barriers to moisture transmission. For example, a film of high density polyethylene (HDPE), or polyvinylidene chloride-methyl acrylate (PVdC-MA) copolymer may be utilized to restrict the movement of water molecules
25 through the film. Oriented polypropylene, metallized oriented polypropylene, or metallized polyester would also be useful as moisture barrier material. In addition, metal foil is known to prevent the transmission of oxygen and/or moisture through polymeric packaging having a layer of metal foil contained therein.

 Although these moisture barrier polymers may be useful in restricting the
30 movement of moisture into a package, some moisture molecules can still make their way into the package to deleteriously affect the product contained therein. In addition, even when barrier materials are effective at restricting the transmission of water molecules through a package, certain features of the package may still allow for the transmission of water molecules. For example, where a barrier material is
35 incorporated into a central layer of a film structure and the film structure is sealed to

another film structure having a barrier material as a central layer, the edges of the package may not be protected by the barrier layers. This may allow moisture to make its way into a package along the edges of a heat sealed package.

One solution to maintaining a particularly low or virtually nonexistent level of moisture within a package is to incorporate sachets of desiccant material into the internal space of the package to remove the moisture from the headspace of the package. A sachet may effectively maintain a very low level of moisture in inside spaces of packages, but may have difficulty maintaining the same consistent moisture levels after the package has been opened and a product has been removed. For example, a typical package of moisture-sensitive products may contain a plurality of the products. A sachet of desiccant material incorporated into the package may only guarantee that moisture level of the package is maintained at a constant or minimal moisture level until the package is opened and the first product is thereby removed. The remaining products will be instantly exposed to atmospheric moisture when the seal of the package is broken. Although the sachet may remove some moisture from the headspace of the package after the package is opened, the remaining moisture-sensitive products, having already been exposed to moisture, may already be damaged. This may be especially true in bulk packaged materials where sachets are most often used. Desiccant materials are typically incorporated into liddings of jars or in sachets of multi-unite packages.

In addition, sachets of desiccant material may become saturated with atmospheric moisture relatively quickly thereby decreasing or eliminating their effectiveness. Moisture-sensitive products, therefore, stand a greater chance of being damaged by moisture in this case.

Moreover, the desiccant material contained in the sachets is typically in powder or granular form and may leak or otherwise spill from the sachets thereby contaminating the product or products contained within the package. For example, if the desiccant material contacts a food product or medical device, the food product or medical device may become contaminated with the desiccant material, which may be damaging to the health of an individual that consumes the food product or uses the medical device.

Additionally, although desiccant material is generally known to reduce the moisture content within a package, typical desiccant materials are "physical" desiccant materials, such as molecular sieves, that bind water molecules within pore

spaces of a material. Typically, physical desiccant materials absorb water at all humidity levels, but will cease to absorb water when interstices of the physical desiccant material are filled. Therefore, physical desiccant materials may be ineffective at high humidity levels.

5 An additional type of desiccant material may be hydrate forming agents such as salts. Typical salts that may be utilized as desiccant material are magnesium sulfate, sodium phosphate di-basic, ammonium chloride, potassium carbonate, potassium aluminum disulfate, magnesium chloride, diammonium sulfate, sodium nitrate, calcium chloride, and calcium sulfate, although many others are known as
10 well. Typically, the drying capacity is greatly influenced by the relative humidity within a package. Generally, no water is taken up by the hydrate-forming agent until the relative humidity reaches a value at which the first hydrate forms. In the case of calcium chloride, for example, the first hydrate occurs at less than about two percent relative humidity (R.H.). Water is then taken up by the hydrate forming salt until the
15 first hydrate is completely formed by the salt. No further water is taken up by the salt until the relative humidity reaches a second level where the second hydrate forms. This process continues through as many hydrates as the agent forms at which point the substance begins to dissolve and a saturated solution is formed. The saturated solution will then continue to take up water.

20 Although these salts may be effective at removing water molecules from a quantity of gas that may be contained within the headspace of a package, since the salt only binds the water molecules within the salt, the water molecules may easily escape back into the package. This is known as breathing, and may cause deliquescence (water droplets and liquidization) inside the package. Typically, this can happen if
25 the salt becomes saturated and if the temperature of the package increases, or if the pressure of the package decreases, which may occur during shipment or storage of the package.

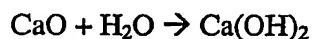
In addition, salts may not allow moisture levels within a package to fall to a level that is necessary to protect the moisture-sensitive product that may be contained
30 within the package. Typically, since salts typically have different levels of hydration, humidity levels may remain a certain level without decreasing until the level of hydration changes.

However, these salts may be utilized to maintain certain humidity levels within the headspace of a package. For example, certain products may require that a

certain level of moisture or humidity be maintained within the package headspace. Headspace humidity control for products can be manipulated by incorporation of the appropriate hydrate forming agents.

Desiccant materials may also be used that form no hydrates, such as common salt (NaCl) or potassium bromide (KBr). For example, common salt will absorb no water at a relative humidity below about 75 percent. When 75 percent relative humidity is reached, a saturated solution is formed which continue to take up water.

The present invention may utilize chemical desiccant technology, which is more preferable because the moisture level within a package may be maintained at an extremely low level. Chemical desiccant materials chemically react with water molecules to form a new product, wherein the water molecules are chemically incorporated into the new product. For example, calcium oxide binds water in the following reaction:



Because the reaction noted above requires very high energy levels to reverse, it is, for all practical purposes, irreversible. Chemical desiccant materials typically absorb water at all humidity levels, and will continue to take up water at high relative humidity levels. These chemical desiccant materials, therefore, may reduce levels of moisture within the package headspace to zero or near zero, which is often desired to maintain maximum dryness of the product.

An example of a moisture-sensitive product that would benefit from the present invention are medical diagnostic testing equipment, such as diagnostic test strips. Medical diagnostic test strips are typically used to test for the presence of particular compounds in a biological fluid, such as blood or urine. For example, diagnostic test strips may detect the presence of narcotics or other substances.

A diagnostic test strip is typically dipped into a sample of the biological fluid and if the individual has traces of narcotics in the sample of the biological fluid then the diagnostic test strip may change colors to indicate the presence of the narcotics.

In addition, diagnostic test strips may be useful to detect particular levels of naturally occurring compounds that may be present within biological fluids. For example, high levels of protein in blood and/or urine may indicate a disease state. Diagnostic strips are useful to test not only for protein levels, but a plurality of other indicators for levels of various disease indicators. Diagnostic strips may also be utilized to detect certain biological conditions, such as pregnancy.

Diagnostic strips, like the ones described above, are typically extremely sensitive to moisture, and must be removed from atmospheric conditions in order to work properly. In the medical field, it is extremely important to get accurate readings using diagnostic testing strips. An inaccurate reading may make it difficult to
5 diagnose a particular disease state, or may make a doctor misdiagnose a particular disease-state entirely. In addition, an inaccurate reading may jeopardize an individual that may test positive for a particular narcotic, especially if the positive result is a false reading. Therefore, it is of utmost importance that diagnostic strips be as accurate as possible.

10 Therefore, diagnostic test strips are typically sealed away from atmospheric conditions. For example, diagnostic test strips are typically wrapped or otherwise contained within a material that is impervious to moisture and oxygen that may cause damage to the diagnostic test strips. A thick plastic or glass plastic package, jar, vial or other container is typically used to house diagnostic test strips prior to use. In
15 addition, sachets of desiccant material are typically incorporated into packaging for diagnostic test strips. However, these packages suffer from the problems as detailed above.

Other examples of typical packages or products that would benefit from desiccant material are electrostatic shielding packaging for electronic parts, such as
20 printer cartridges, circuit boards, televisions, DVDs, printers, modems, personal computers, telecommunications equipment, etc., and in pharmaceutical and/or nutraceutical packaging, such as inside pill bottle caps. Further, other packaging that would benefit from desiccant material is packaging for foods, such as cheese, peanuts, coffee, tea, crackers, spices, flour, bread, etc. In addition, other products that would
25 benefit from desiccant material incorporated into the packaging are shoes, boots, film products and cameras, and products that may be shipped by sea, such as high-value wood like mahogany that would be damaged if exposed to ambient humidity typically found in cargo ships.

A need, therefore, exists for polymeric plastic packaging that may be used in
30 packaging to preserve products that may be sensitive to atmospheric moisture. The packaging may comprise films having a desiccant material incorporated directly into a sealant layer of the film. In addition, films are needed that effectively control the level of moisture within packaging without using sachets or desiccant beads that may become ineffective over time, or that may contaminate products contained within the

packaging. Moreover, films, methods of use and manufacture are needed to overcome the additional disadvantages as noted above with respect to sachets, beads or physical desiccants.

Summary of the Invention

5 The present invention relates to multilayer plastic polymeric flexible packaging films having a desiccant material incorporated within a layer of the film. More specifically, the present invention relates to a polymeric flexible film having a desiccant material incorporated within a layer of the film that is utilized as a package for a product that may be sensitive to the presence of moisture. In addition, the
10 present invention relates to methods of manufacturing and using the polymeric film having a desiccant material incorporated therein.

 It is, therefore, an advantage of the present invention, to provide a polymeric plastic packaging film having a desiccant material incorporated therein for packages that may contain moisture sensitive products. These products may be, for example,
15 foodstuffs and/or other products that may suffer from the deleterious effects of moisture. Specifically, diagnostic strips that are useful in health care may be packaged using a film having a desiccant material contained within a layer of the film to maintain the utility of the diagnostic strip. The desiccant material is utilized to control the moisture level within a package made by the film of the present invention.
20 The desiccant materials may be utilized as an alternative to high cost and marginally effective desiccant sachets or beads that may ruin the product within the package if the desiccant sachet breaks open or is otherwise allowed to contaminate the product within the package.

 In addition, it is an advantage of the present invention to provide a film having
25 a desiccant material incorporated therein that would eliminate the need to incorporate into high cost and marginally effective sachets or beads of desiccant material that may contaminate products contained within packages if the sachets accidentally release the desiccant material into the package. Moreover, sachets or beads may be unsightly and may take up space within a package that could otherwise be used for product. If the
30 desiccant material within the sachets or beads are ingested, they may become a health hazard. By the present invention, the desiccant material is incorporated directly into the packaging film in a rigid solid state in the packaging film substrate.

 Moreover, it is an advantage of the present invention to provide a film wherein the desiccant material is incorporated into the sealant layer of the film and wherein the

Detailed Description of the Presently Preferred Embodiments

The present invention relates to films, film structures, packages and methods of using and/or manufacturing the films, film structures and packages of the present invention. Specifically, the films comprise a desiccant material incorporated into the films as an integrated component. More specifically, the desiccant material is contained within a heat sealant layer of a film structure. The film structure may be utilized to produce a package for a moisture-sensitive product wherein said package has a first film structure in face-to-face contact with a second film structure and wherein said film structures are heat sealed together around the edges of the package while the product is contained therein. Although many types of moisture-sensitive products may be contained within the packages made from the films or film structures of the present invention, the packages made therefrom are especially useful for packaging diagnostic test strips.

Now referring to the drawings, wherein like numerals refer to like parts, FIG. 1 illustrates a film 1 of the present invention. The film 1 may be made from a polymeric material, such as a polyolefinic material. Preferably, the film may comprise polyethylene selected from the group consisting of ultra low density polyethylene, low density polyethylene, linear low density polyethylene, medium density polyethylene, and high density polyethylene, and may be made via any known method of making polyethylene, such as via Ziegler-Natta catalysts, or single-site catalysts, such as metallocene catalysts. Moreover, the film may preferably comprise ethylene copolymers, such as ethylene alpha-olefin copolymers, ethylene-methyl acrylate copolymer, ethylene vinyl acetate copolymer, ethylene acrylic acid, ethylene methyl acrylic acid copolymer, ionomer (Surlyn), and other like polymers. In addition, the film may comprise polypropylene homopolymer or copolymer, either alone or blended with polyethylene or polyethylene copolymers, as noted above.

The film 1 may further comprise a desiccant material 10 blended therein, such as any known desiccant material that may blend with polymeric resins that can be made into films. Specifically, desiccant materials that may be useful for the present invention include calcium oxide, magnesium sulfate, sodium phosphate di-basic, ammonium chloride, potassium carbonate, potassium aluminum disulfate, magnesium chloride, diammonium sulfate, sodium nitrate, calcium chloride, calcium sulfate, sodium chloride, potassium bromide, molecular sieves, clays, or any other desiccant

material apparent to one having ordinary skill in the art. Chemical desiccant materials are preferred, such as calcium oxide.

Chemical desiccant materials are preferred because chemical desiccant materials irreversibly bind water molecules within the crystalline product via a chemical reaction. The water molecules typically cannot be released into the package at higher temperatures or lower pressures. In addition, chemical desiccant materials may more effectively remove humidity from the headspace of a package made from the film 1. Hydrate-forming salts may also be used, and may effectively maintain constant relative humidity levels within the headspace of a package made from the film 1. For example, magnesium sulfate may be blended with polyethylene or another polymeric material to form a package that may maintain a relative humidity level inside said package at about 35%. However, other levels of humidity may be maintained depending on the hydration levels or state of the magnesium sulfate within the polymer material.

The desiccant material can be incorporated into the film 1 at a level of between about one weight percent and about 90 weight percent. More preferably, the desiccant material can be incorporated into the film 1 at a level of between about 20 weight percent and about 60 weight percent. Most preferably, the desiccant material can be incorporated into the film 1 at a level of about 30 weight percent.

Specifically, the film 1 may comprise a quantity of a masterbatch of polymer and desiccant material. The masterbatch comprises polyethylene having calcium oxide blended therein. Specifically, the masterbatch comprises about 50 percent by weight polyethylene and about 50 percent by weight calcium oxide. The masterbatch is further blended into another polymeric material, such as low density polyethylene, in a ratio of about 60 percent by weight masterbatch and 40 percent by weight low density polyethylene. Therefore, the film 1 may preferably have a desiccant material content of about 30 weight percent in the film 1.

It should be noted that although the film 1 is illustrated as a single independent layer, film 1 may be incorporated into a multilayer structure such as via coextrusion with other film layers, extrusion or coextrusion coating, adhesive lamination, extrusion lamination or any other method of making multilayer film structures having a sealant layer comprising a desiccant material with other film layers.

FIG. 2 illustrates a film structure 100 of the present invention, incorporating a film layer 110 having a desiccant material incorporated therein, as detailed above with

relation to the film 1. Specifically, the film layer 110 may comprise a polyolefinic material, such as polyethylene, as described above, or polypropylene. Preferably, the polyolefinic material comprises polyethylene. The desiccant material may comprise a chemical, physical, or hydrate-forming desiccant material, although a chemical
5 desiccant material is preferred.

In addition, the film layer 110 may be between about 1 mils and about 10 mils thick and may form a sealant layer or a product contacting layer in a package made from the film structure 100. More preferably, the film layer 110 may be between about 1 mils and 5 mils thick. Most preferably, the film layer 110 can be between
10 about 1.5 mils and about 3.5 mils thick.

The remaining film layers of a film structure of the present invention may be any material that may be utilized to form a package with the film layer 110 as a sealant layer or a product contacting layer. Moreover, any number of layers may be incorporated into the film structure 100 as may be needed to form a package having
15 desired characteristics. The preferred film structure of the present invention includes the heat sealant layer 110, as noted above. The heat sealant layer 110 may be adhered to a barrier layer 114 by a tie or adhesive layer 112. In addition, the film structure 100 may comprise an outer layer 120 adhered to said barrier layer via a second tie or adhesive layer 116 disposed between said outer layer 120 and said barrier layer 114.
20 Finally, the presently preferred film structure 100 of the present invention may comprise a primer layer or printed layer 118 disposed between said outer layer 120 and said tie adhesive layer 116.

Preferably, tie or adhesive layer 112 may be a blend of low density polyethylene (LDPE) and ethylene acrylic acid copolymer (EAA). Barrier layer 114
25 may be made of a metal foil, such as aluminum foil, nylon, high density polyethylene, polypropylene, such as oriented polypropylene and metallized oriented polypropylene, or metallized polyester, and may be any thickness that may be necessary to reduce pin-holing and therefore reduce the transmission of gases through the film structure 100. Preferably, the barrier layer 114 may be about 0.35 mils when
30 the barrier layer 114 is aluminum foil. Of course, the barrier layer may be other thicknesses depending on the barrier material that is utilized. The EAA of tie or adhesive layer 112 may aid in binding the polyolefinic material of the heat sealant layer to the metal foil layer 114. Film layer 116 may be a blend of LDPE and EAA and may be similar, if not identical, to film layer 112. Film layer 118 may be a primer

layer and/or a printed layer. If the film layer 118 is a printed ink or pigment layer, it may form a printed label or other printed indicia on the film structure 100. Finally, film layer 120 may be an outer abuse layer, and may comprise polyethylene terephthalate (PET), oriented polypropylene (OPP), polyethylene, nylon, foil, metallized substrates, or any other material apparent to one having ordinary skill in the art.

As stated above, the barrier layer 114 may be a metal foil that may be any thickness to reduce the transmission of moisture through the film. The number of pinholes present in a metal foil is inversely related to the foil thickness. Therefore, a thicker foil tends to have fewer pinholes. However, if the desiccant material of the present invention is in the heat sealant layer 110, thinner foil can be utilized in packages made from the film structure 100.

Metal foil is typically utilized to provide an effective barrier against moisture transmission through a film structure. However, metal foil can be relatively expensive and difficult to process. Therefore, the desiccant sealant layer 110 is effective at reducing or eliminating the transmission of moisture that may pass through relatively thin metal foil. Desiccant films, therefore, add significant protection to the inside space of a package made from the film structure 100 in addition to the inherent barrier protection provided by metal foil. Barrier layers may be relatively thinner when a film structure incorporates a desiccant sealant layer into the film structure, thereby saving on cost.

FIG. 3 illustrates a package 200 made from a film structure of the present invention. Specifically, the package 200 is made from the film structure 100, as illustrated with respect to FIG. 2, described above. Specifically, the package 200 may comprise two film structures that are heat sealed together via a heat seal 202 that is formed around a perimeter of the package 200. Alternatively, the package 200 may comprise a single film structure that is folded and heat sealed around the perimeter of the package 200. The package 200 may further comprise a space 204 to contain a product 206. The product 206 may be sensitive to moisture, so that a desiccant material contained within the film structure or film structures reduces or eliminates the amount of water molecules within the space 204. A preferable product contained within the package 200 may be a diagnostic test strip useful in the medical field. A single diagnostic test strip may be contained within the package 200 so that when

opened and the diagnostic test strip is removed, there are no other test strips within the package 200 to be contaminated by moisture.

FIG. 4 illustrates a cross-section of the package 200 along line IV-IV, in an embodiment of the present invention. The cross-section shows two film structures 210, 212 that are heat sealed together at heat seals 202. The two film structures may be identical, and may comprise the same film layers as described above with respect to film structure 100. Specifically, the two film structure 210, 212 may comprise a plurality of layers: a first sealant layer 110 of a polyolefinic material and a desiccant material; a second layer 112 of a blend of low density polyethylene and ethylene acrylic acid copolymer; a third layer 114 of a foil material; a fourth layer 116 of a blend of low density polyethylene and ethylene acrylic acid copolymer; a fifth primer layer 118; and a sixth layer 120 of PET. The product 206, such as a diagnostic test strip, is contained within the package 200 in the space 204.

While foil can reduce or effectively eliminate water transmission through film structures 210, 212 of the package 200, it cannot completely eliminate the transmission of moisture through the edges of the film structure. For example, FIG. 3 illustrates the cross-section of the package 200 along line IV-IV. As shown, the metal foil layer 114 of each film structure 210 and 212 are displaced from the portions of the film structure 210 and 212 that are heat sealed together. Therefore, there is an area 214 that is not protected by the metal foil layer 114 that may transmit water molecules into the space 204. If the desiccant material is incorporated into the heat sealant layer 110, then the desiccant material effectively blocks moisture from passing into the interior space 204 of the package 200 thereby protecting the moisture sensitive product contained therein.

The film layers of the film structure 100 may be made via cast coextrusion, extrusion coating and/or extrusion lamination, adhesive lamination, blown-film coextrusion or monolayer extrusion or any other film making method generally known to those having ordinary skill in the art. Preferably, the heat sealant layer may be made by compounding the desiccant material into the polymeric resin, and extruding or coextruding via blown extrusion, cast extrusion into a monolayer film or a multilayer film. The remainder of the film structure may be extrusion or adhesive laminated together with the monolayer film or multilayer film. The desiccant heat sealant layer can be laminated to the remainder of the film structure, including the barrier layer of the film structure.

As noted in the above paragraph, several methods exist for constructing an effective flexible package using the present invention. These methods include, but are not limited to:

1. Blown film monolayer extrusion or multilayer coextrusion wherein the sealant film is extrusion laminated to a barrier material. This method is preferred.

2. Blown film monolayer extrusion or multilayer coextrusion wherein the desiccant sealant film is adhesive laminated to a barrier material with the use of adhesives and/or primers to bond the desiccant sealant film to the barrier layer.

3. Cast film monolayer extrusion or multilayer coextrusion wherein the sealant film is extrusion laminated to a barrier layer.

4. Cast film monolayer extrusion or multilayer coextrusion wherein the desiccant sealant film is adhesive laminated to barrier materials with the use of adhesives and/or primers to bond the desiccant sealant film to the barrier layer.

5. Extrusion or coextrusion coating wherein the desiccant sealant layer and/or an adhesive layer are extrusion or coextrusion coated directly onto the barrier layer.

Of course, any other methods of making films, film structures, and packages of the present invention may be utilized as may be apparent to one having ordinary skill in the art. Moreover, although film structures having barrier materials incorporated therein as a barrier layer of the film structures are preferred, other film structures such as those not having a barrier material or barrier layer may also be produced as apparent to one having ordinary skill in the art.

Examples

The following examples are illustrative of preferred embodiments of the present invention, as described above, and are not meant to limit the invention in any way.

5 Example 1

The following Table 1 illustrates preferred materials and gauges for the film structure 100, as described above and illustrated with respect to FIG. 2.

Table 1.

Material	Gauge
PET	0.48 mils
INK	0.1 mils
LDPE/EAA blend	0.5 mils
Foil	0.35 mils
LDPE/EAA blend	0.5 mils
LDPE/CaO blend	1.5 mils

10 Example 2

The following Table 2 illustrates preferred materials and gauges for the film structure 100, as described above and illustrated with respect to FIG. 2, in an alternate embodiment of the present invention.

Table 2.

Material	Gauge
PET	0.48 mils
INK	0.1 mils
LDPE/EAA blend	0.5 mils
Foil	0.35 mils
LDPE/EAA blend	0.5 mils
LDPE/CaO blend	2.5 mils

15

Example 3.

The following is a preferred embodiment of the package 200, described above and illustrated with respect to FIG. 3. The package may be made from film structures noted above, and preferably with respect to Examples 1 and/or 2. Specifically, the

package 200 may be for diagnostic test strips. Each package may be about 5.25 in. long and about 2.25 in. wide. The heat seals that are created around the perimeter of the packages are about 0.25 in. wide. Taking into consideration the heat seals, each package would have a total exposed internal surface of about 16.6 in.²

- 5 It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is, therefore, intended that such changes and modifications be covered
- 10 by the appended claims.

Claims

We claim:

1. A flexible film structure comprising:
a barrier layer comprising a barrier material that blocks the transmission of
5 moisture through the film structure; and
a sealant layer comprising a desiccant material.
2. The flexible film structure of claim 1 wherein said desiccant material is a chemical desiccant material.
3. The flexible film structure of claim 1 wherein said desiccant material is
10 selected from the group consisting of calcium oxide, magnesium sulfate, sodium phosphate di-basic, ammonium chloride, potassium carbonate, potassium aluminum disulfate, magnesium chloride, diammonium sulfate, sodium nitrate, calcium chloride, calcium sulfate, sodium chloride, potassium bromide, molecular sieves, clays and blends of these materials.
- 15 4. The flexible film structure of claim 1 wherein said barrier material is selected from the group consisting of metal foil, nylon, high density polyethylene or oriented polypropylene, metallized oriented polypropylene, and oriented polyester.
5. The flexible film structure of claim 1 further comprising a first tie layer of a polymeric material disposed between said barrier layer and said sealant layer.
- 20 6. The flexible film structure of claim 5 wherein said first tie layer of polymeric material comprises ethylene acrylic acid copolymer.
7. The flexible film structure of claim 5 further comprising:
an outer layer of a polymeric material.
8. The flexible film structure of claim 7 wherein said outer layer comprises a
25 polymeric material selected from the group consisting of PET, oriented polypropylene, polyethylene, nylon, foil, or metallized substrates.
9. The flexible film structure of claim 7 further comprising a second tie layer disposed between said outer layer and said barrier layer.
10. The flexible film structure of claim 9 wherein said second tie layer
30 comprises ethylene acrylic acid copolymer.
12. A package comprising:
a flexible film wherein said flexible film comprises a barrier layer having a barrier material that blocks the transmission of moisture through the film structure and a sealant layer comprising a desiccant material; and

a space inside the package for a moisture-sensitive product.

13. The package of claim 12 wherein said desiccant material is a chemical desiccant material.

14. The package of claim 12 wherein said desiccant material is selected from the group consisting of calcium oxide, magnesium sulfate, sodium phosphate di-basic, ammonium chloride, potassium carbonate, potassium aluminum disulfate, magnesium chloride, diammonium sulfate, sodium nitrate, calcium chloride, calcium sulfate, sodium chloride, potassium bromide, molecular sieves, clays and blends of these materials.

15. The package of claim 12 further comprising a second flexible film wherein said second flexible film comprises a barrier layer having a barrier material that blocks the transmission of moisture through the second flexible film structure and a sealant layer comprising a second desiccant material, wherein said first and second flexible film structures are heat sealed together to form the package having the space inside the package for said moisture-sensitive product.

16. The package of claim 15 wherein said second desiccant material is a chemical desiccant material.

17. The package of claim 12 further comprising:
an outer layer of polyethylene terephthalate;
a first tie layer disposed between said sealant layer and said barrier layer; and
a second tie layer disposed between said barrier layer and said outer layer.

18. A method of making a flexible film structure, comprising the steps of:
extruding a film layer comprising a blend of a polymeric material and a desiccant material; and
laminating said film layer to a moisture barrier layer.

19. The method of claim 18 wherein said film layer is extruded via a blown film extrusion process.

20. The method of claim 18 wherein said film layer is extruded via a cast film extrusion process.

21. The method of claim 18 wherein said film layer is adhesive laminated to said barrier material.

22. The method of claim 18 wherein said film layer is extrusion laminated to said barrier material.

23. The method of claim 18 further comprising the steps of:

coextruding a tie layer with said film layer comprising the blend of polymeric material and the desiccant material; and

laminating said tie layer and said film layer comprising the blend of polymeric material and the desiccant material to said barrier layer.

5 24. The method of claim 18 wherein said barrier layer comprises a material selected from the group consisting of metal foil, nylon, high density polyethylene, oriented polypropylene, metallized oriented polypropylene, and metallized polyester.

25. A package having a space therein for a moisture-sensitive product made from the film structure made from the method of claim 18 wherein said first layer is a
10 heat sealant layer.

26. The package of claim 25 wherein said product comprises a medical diagnostic test strip.

27. A method of making a flexible film structure, comprising the steps of:
extrusion coating a film layer comprising a blend of a polymeric material and
15 a desiccant material to a moisture barrier film layer.

28. The method of claim 25 wherein said moisture barrier film layer comprises a material selected from the group consisting of metal foil, nylon, high density polyethylene, oriented polypropylene, metallized oriented polypropylene, and metallized polyester.

20 29. The method of claim 25 wherein said film comprising the blend of the polymeric material and the desiccant material is coextruded with at least one other film layer.

30. A package having a space therein for a moisture-sensitive product made from the film structure made from the method of claim 18 wherein said first layer is a
25 heat sealant layer.

31. A package having a space therein for a moisture-sensitive product made from the film structure made from the method of claim 27 wherein said first layer is a heat sealant layer.

32. The package of claim 31 wherein said product comprises a medical
30 diagnostic test strip.

FIG. 1

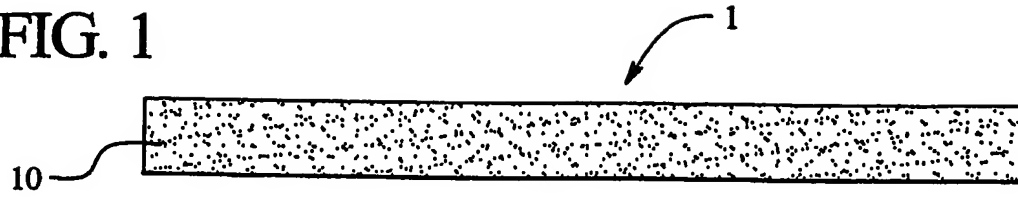


FIG. 2

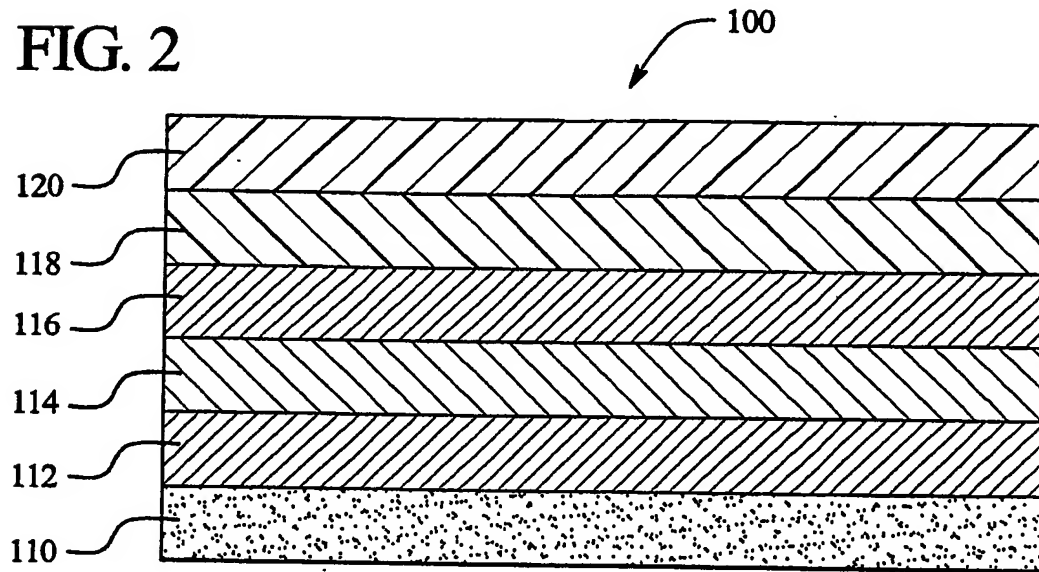


FIG. 3

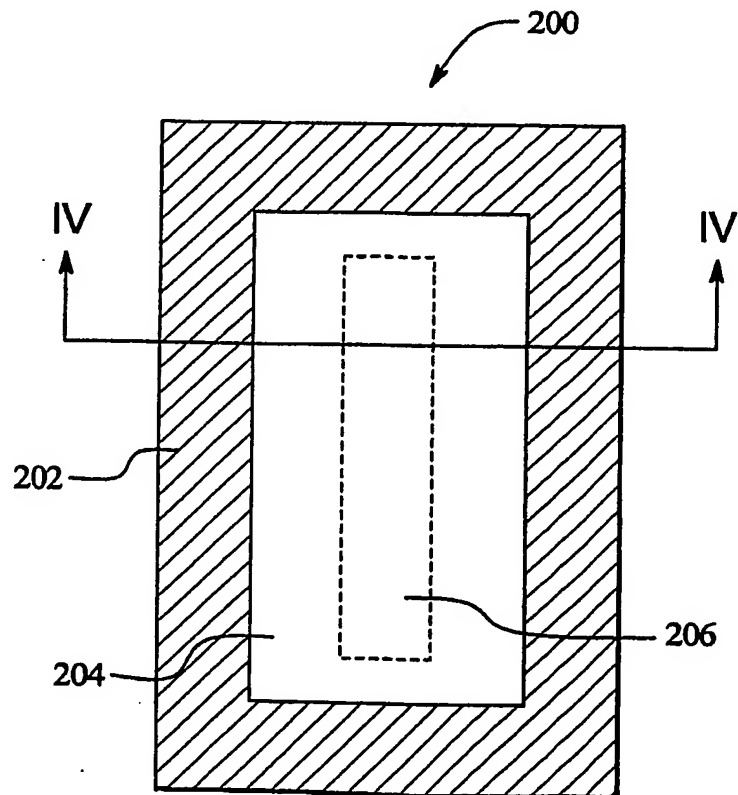
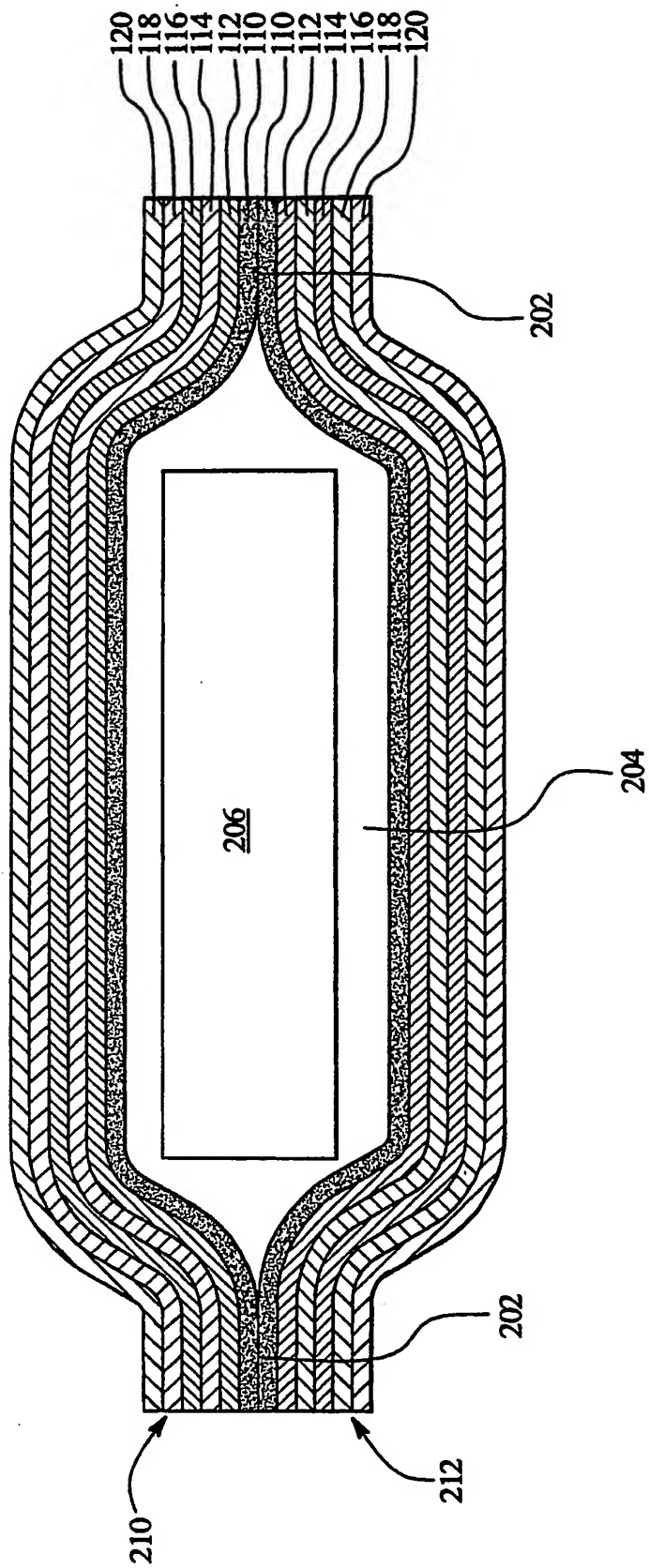


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/19298

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B32B 1/08,1/10,15/08,27/08,27/32,27/34,27/36; B65D 81/26; B29C 47/02,47/06; B29D 22/00
US CL : 428/35.7,35.2,35.3,35.8,35.9,458,461,469,475.5,476.1,483,515; 206/204; 264/173.12,173.14; 156/244.11
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 428/35.7,35.2,35.3,35.8,35.9,458,461,469,475.5,476.1,483,515; 206/204; 264/173.12,173.14; 156/244.11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,911,344 A (KAHLER) 27 March 1990 (27.03.1990), column 3, lines 25-41 and Figure 5 and column 1, lines 5-7.	1, 4, 12, 25-26, and 30-32
X	US 4,464,443 A (FARRELL et al) 7 August 1984 (07.08.1984), columns 2-4 and 6.	1-5,7-9,12-16,18,21-32
X	US 2002/0006483 A1 (NETELER) 17 January 2002 (17.01.2002), Figure 1 and Paragraphs 8-12 and 19.	1,4-10,12,15,17,19-32
A	US 4,753,845 A (SUMI et al) 28 June 1988 (28.06.1988), whole document.	1-10,12-32
A	US 5,788,064 A (SACHERER et al) 4 August 1998 (04.08.1998), whole document.	1-10,12-32

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

02 September 2003 (02.09.2003)

Date of mailing of the international search report

25 SEP 2003

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